CAMBRIDGE
International Education

Cambridge International AS & A Level

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **May/June 2024**

MARK SCHEME

Maximum Mark: 60

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

PUBLISHED

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptions for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	<u>'List rule' guidance</u> For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

This mark scheme will use the following abbreviations:

;	separates marking points
/	separates alternatives within a marking point
()	contents of brackets are not required but should be implied / the contents set the context of the answer
R	reject
A	accept (answers that are correctly cued by the question or guidance you have received)
I	ignore (mark as if this material was not present)
AW	alternative wording (where responses vary more than usual, accept other ways of expressing the same idea)
AVP	alternative valid point (where a greater than usual variety of responses is expected)
ORA	or reverse argument
underline	actual word underlined must be used by the candidate (grammatical variants excepted)
MAX	indicates the maximum number of marks that can be awarded
+	statements on both sides of the **+** are needed for that mark
OR	separates two different routes to a mark point and only one should be awarded
ECF	error carried forward (credit an operation from a previous incorrect response)

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)(i)</td><td>7 nm ; A a suitable range
A within the range 5 to 10 nm
unit must be shown</td><td>1</td></tr>
<tr><td>1(a)(ii)</td><td>one mark per row – name and letter must agree in row 3 – glycolipid and glycoprotein
If no rows are correct or one row is correct, mark by column to give max 2 if one or two columns are correct

<table>
<tr><th>component</th><th>function</th><th>letter on Fig.1.1</th><th></th></tr>
<tr><td>channel protein</td><td>facilitated diffusion
or
transport of, water / ions / water soluble substances / polar molecules / charged substances / hydrophilic substances
I named examples of each category</td><td>A</td><td>;</td></tr>
<tr><td>phospholipid</td><td>forms a bilayer
or
a role within bilayer
e.g. barrier to, water soluble / polar substances / ions
allows diffusion of, fat soluble / non-polar, substances
allows fluidity / provides stability / forms a hydrophobic core / AW</td><td>E</td><td>;</td></tr>
<tr><td>glycoprotein
A glycolipid</td><td>receptor for cell signalling</td><td>B
D</td><td>;</td></tr>
<tr><td>cholesterol</td><td>gives (mechanical) stability / maintains fluidity / regulates fluidity / barrier to water soluble substances
or
at low temperatures, maintains or increases fluidity / prevents close packing
A prevents hydrophobic ‘tails’ interacting at low temperatures
or
at high temperatures, stabilises the membrane / decreases fluidity</td><td>F</td><td>;</td></tr>
</table>
</td><td>4</td></tr>
</table>

Question	Answer	Marks
1(b)(i)	*each organelle must be drawn in the cytoplasm and labelled for a mark* *max 2 if organelles are drawn correctly but not labelled or are not labelled correctly* *labels must clearly identify the organelles* **R** *any 3D drawings* mitochondrion with two membranes and at least one crista **;** rough endoplasmic reticulum with at least one cisterna (two lines close together) and ribosomes attached on the outside **;** **R** if any ribosomes completely inside the organelle smooth endoplasmic reticulum with at least one tube with no ribosomes **;** **A** RER and SER as labels **A** if RER or SER attached to nuclear envelope	**3**
1(b)(ii)	Golgi body / dictyosome **;** **A** Golgi, apparatus / complex *plus any **one** from:* modifies / processes, protein(s) / polypeptide(s) / lipid(s) **;** **A** any suitable type of modification or a description e.g. glycosylation / addition of sugars forming tertiary or quaternary structures packaging of proteins into (Golgi) vesicles **;** **I** transports AVP **;** e.g. forming lysosomes / cell wall enzymes assembled	**2**

Question	Answer	Marks
2(a)	*any **three** from:* **1** water is a, good / universal / AW, solvent **;** **A** dissolves many substances / description of solvent action **A** solvent for / dissolves, (named) ions **and** (named) polar molecules **2** transport of one named substance for a correct reason **;** e.g. urea for excretion **3** high specific heat capacity **; A** a full description e.g. the amount of heat that must be added to, one unit of mass of the substance / 1 gram *or* 1 cm^3 of water, to increase the temperature by, one unit / 1 °C **4** so temperature of blood remains (fairly) constant / heat is dispersed throughout the body **;** *must be linked to mp**3*** **I** temperature of water is constant AVP **;** e.g. water is (di)polar	**3**
2(b)(i)	**P** - aorta **A** dorsal aorta **Q** - vena cava **; I** superior and inferior	**1**
2(b)(ii)	**1** aorta / **P**, transports / delivers / AW, oxygenated blood to the, organs / body / respiring tissues / systemic circulation **or** aorta / **P**, transports / AW, blood at high pressure to, organs / body / respiring tissues / systemic circulation **;** **2** vena cava / **Q**, transports / returns / AW, deoxygenated blood to the, right atrium / heart (from systemic circulation) **or** vena cava / **Q**, transports / AW, blood at low pressure to the, right atrium / heart **;** **A** vena cava / **Q**, collects blood from, veins / systemic circulation *alternative* **3** aorta / **P**, transports oxygenated blood and, vena cava / **Q**, transports deoxygenated blood **;** **4** blood in aorta to, organs / body / respiring tissues / systemic circulation, and blood in vena cava to, right atrium / heart **;**	**2**

Question	Answer	Marks
2(b)(iii)	*closed* blood is contained within vessels **;** **A** at least three from heart, arteries / arterioles, veins / venules, capillaries *double* blood flows twice through the heart in, one / each, (complete), circuit/circulation (of the body) **;** **A** pulmonary circulation and systemic circulation **A** described	**2**
2(c)(i)	*any **two** from:* (blood at high pressure) will, burst / damage, capillaries **;** **A** cannot withstand high pressure capillaries have thin walls / capillary walls are composed of one (thin) layer of (endothelial) cells **;** **A** capillary walls are one cell thick **R** capillaries have cell walls *idea that a*t low pressure blood flows slowly to allow, exchange / diffusion, of substances (in capillaries) **;** **A** efficient exchange (of substances) AVP **;** e.g. *idea that* pressure will be low at venous end of capillaries so that tissue fluid is reabsorbed	**2**

Question	Answer	Marks
2(c)(ii)	*any **three** from:* ***I** functions* *similarities* **1** (both have) endothelium / tunica intima **;** **A** tunica interna **2** both have) tunica media / <u>smooth</u> muscle **;** *differences* *muscular artery – accept **ora** for arteriole* **3** smaller lumen to wall thickness / ratio of wall thickness to lumen width is smaller **;** **A** thicker wall **; I** artery is 'bigger / thicker / wider', unqualified **4** wider lumen **;** **5** more <u>smooth</u> muscle (layers) / thick (layer) v thin (layer), <u>smooth</u> muscle **;** **A** thicker tunica media **6** more / presence of, elastic, fibres / tissue **;** **A** no elastic lamina **7** more / presence of, collagen (fibres) **;** **8** AVP **;** e.g. *ref. to* blood vessels in wall of artery (vasa vasorum) e.g. no vesicles in endothelium e.g. artery has, tunica externa / adventitia **A** tunica externa not (clearly) visible in arteriole	**3**
3(a)	(insect) vector / *Anopheles* / (a) mosquito **;** *Plasmodium, falciparum* / *ovale* / *malariae* / *vivax* **;** **A** *knowlesi* *Vibrio cholerae* **and** cholera **;** **A** other pathogens and associated diseases that are transmitted in the same way *Mycobacterium*, *tuberculosis* / *bovis* **;** airborne droplets / droplet infection / aerosol (infection) **;** **I** air droplets **I** water droplets from, coughing / sneezing **A** alternative transmission only if *Mycobacterium bovis* stated e.g. (eating) contaminated meat (from infected cattle) (drinking) contaminated milk (drinking) unpasteurised milk from contaminated, cows / cattle	**5**

Question	Answer	Marks
3(b)	*any **two** from:* tenofovir competes with, (activated / phosphorylated) adenine nucleotide / deoxyribose adenosine triphosphate / dATP, for active site / to prevent nucleotides being added to elongating chain **;** **A** (tenofovir acts as a) competitive inhibitor (of reverse transcriptase) tenofovir forms a phosphodiester bond to elongating DNA strand, but stops further reactions / AW **;** tenofovir has, no 3´ -OH so next nucleotide cannot form a phosphodiester bond / no (deoxy)ribose so cannot form phosphodiester bond **;** **A** pentose **R** sugar unqualified	**2**
3(c)(i)	20 (%) **; R** answers with decimal places	**1**

Question	Answer	Marks
3(c)(ii)	*there must be at least one statement or at least one explanation to gain max 4, otherwise mark to max 3* *any **four** from:* **1** supply, condoms / femidoms / dental dams / item(s) for protection during sex **;** **2** barrier to transmission during sexual intercourse **;** **3** *ref. to*, needle exchange schemes / other suitable support for intravenous drug (ab)users **; I** clean needles **4** decreases risk of sharing contaminated equipment / AW **;** **5** use, new needles / new syringes / sterilised equipment / AW, for medical procedures **; I** clean needles **6** decreases risk of transmission from contaminated blood **;** **7** provide testing for HIV, in high risk groups / to individuals at high risk **;** **8** for early diagnosis so newly infected people so can start drug treatment immediately **;** **8** test pregnant women for HIV / provide powdered milk to women who are HIV positive **;** **9** prevent women who are HIV positive passing HIV in breast milk **;** **10** prevent people who are HIV positive being blood donors / screen donated blood / heat-treat donated blood **;** **11** prevent people receiving blood infected with HIV, during blood transfusions / operations **;** **12** carry out contact tracing **;** **13** locate people who, are undiagnosed / may be HIV positive / should be offered test **;** **14** supply (named) drug(s) to people, living with HIV / who are HIV positive / pregnant women with HIV **;** **15** prevents HIV, spreading throughout the body / infecting more T-lymphocytes **; A** to reduce viral load **16** provide, education / information, about, HIV treatments / HIV transmission **;** **17** to raise awareness of ways to reduce infection / AW **; A** use of barrier methods during sex / safer sex **18** AVP **;** e.g. law to make it illegal to knowingly transmit the virus	**4**
4(a)(i)	**A** – ciliated epithelial (cell) **; R** ciliated epithelium **B** – goblet (cell) **;**	**2**

Question	Answer	Marks
4(a)(ii)	**1** goblet cells / **B**, secrete / produce / release, mucus / mucin **;** **2** mucus, covers / AW, the (ciliated) epithelium to trap (named) particles **;** **or** *idea that* mucus prevents (named) pathogens reaching, epithelial cells / alveoli / gas exchange surface **; I** lungs **A** acts as a barrier to (named) pathogens **3** cilia / ciliated epithelial cells, move mucus (and trapped material), upwards / towards mouth / towards throat **or** pharynx / away from alveoli / away from gas exchange surface / away from lungs / out of the airways **;** **I** 'out of the lungs' / 'to be swallowed' unqualified / out of the respiratory system / out of the gas exchange system	**3**
4(b)(i)	9+2, pattern / arrangement / structure **;** composed of microtubules **;** AVP **;** e.g. *ref. to* dynein 'arms' / AW outer 9 are, pairs of microtubules / doublets, and central two are single	**2**
4(b)(ii)	*idea that* each cilium / structure **X**, is surrounded by cell (surface) membrane (so contents are inside the, cell / cytoplasm) **;**	**1**
4(c)	*must have either mp1 or mp2 or both to gain max 4, otherwise max 3* **1** (centrioles) make / organise, microtubules **; A** microtubular organising centre / MTOC **2** to form, the spindle / spindle fibres **;** **3** (during each cell cycle) each centriole, replicates / duplicates / forms two centrioles **;** **4** during, S phase / G2 phase **; A** before mitosis *mp4 is linked to mp3* **5** centriole pairs / centrioles, move to the (opposite) <u>poles</u> (of cell during prophase of mitosis) **;** **R** if incorrect phase **R** 'poles of nucleus' **6** centrioles, lengthen / shorten, the spindle fibres / microtubules **; I** 'contract'	**4**

Question	Answer	Marks
5(a)	*both units must be used at least once* *any **three** from:* **1** no transpiration when LVPD is 0 kPa **;** **2** (both) increase in transpiration rate until 2.5 kPa **;** **3** *H. annuus* rate remains constant between 2.5 and 3.0 kPa, *N. oleander* rate decreases slightly **;** **4** *H. annuus* has higher rate of transpiration (at all LVPDs) **; ora** for *N. oleander* **5** *H. annuus* has a higher rate of increase (between 0 and 2.5 kPa) **; A** steeper gradient **6** any comparative data quote from Fig. 5.1 **;** *must include figures and units from both axes <u>and</u> data must come from both species*	**3**
5(b)	*if a correct adaptation does not match the figure, allow ecf for the explanation Fig. 5.3* *any **four** from:* **1** three layers of thick-walled cells at, upper / lower, surface **;** **A** two layers of cells under epidermis / epidermis and (two layers of) hypodermis **2** reduces, diffusion of water vapour to atmosphere / cuticular transpiration **;** **A** increases the distance for water vapour to diffuse **3** no stomata on upper surface / stomata only on lower surface **;** **4** stomata not exposed to direct sunlight / AW **;** **5** (stomata in) pits / depressions / cavities / chambers / crypts / infoldings / grooves / AW (on lower side of leaf) **;** **6** creates humid atmosphere in, pit / AW *or* reduces the, diffusion / water potential, gradient (for water vapour) **;** **A** vapour pressure gradient **A** minimises effect of, external air currents / wind *Fig. 5.3 or Fig. 5.4* **7** thick walled epidermis **;** **8** reduces diffusion of water vapour through lower epidermis **;** **9** thick (waxy) cuticle (on epidermis / surface) **;** **10** reduces diffusion of water vapour through cuticle / reduces cuticular transpiration **; A** (waxy) cuticle is waterproof **11** (epidermal) hairs / trichomes (around stomata / fill pits) **;** **12** reduces air movement / traps still air / creates humid atmosphere / traps water vapour *or* reduces the, diffusion / water potential, gradient for water vapour **;**	**4**

Question	Answer	Marks
6(a)(i)	*any **two** from:* **1** (antigen-binding site / variable region) has a shape that is <u>complementary</u> to antigen **; A** tertiary / quaternary, structure **2** (antigen-binding site / variable region has) specific, sequence(s) of amino acids / primary structure(s) **;** **3** *idea that* different amino acids have different, R-groups / side chains, so give different, tertiary structures / shapes (for binding to antigens) **;** **4** AVP **;** e.g. correct *ref. to* epitope(s)	**2**
6(a)(ii)	*idea that* allows flexibility for binding (to antigens) **;** **A** at different angles for flexibility / allows variable region(s) to move	**1**
6(a)(iii)	*any **one** from:* *idea that* easier for macrophage to engulf, antibodies that have bound antigens / antibody-antigen complexes **;** facilitates / AW, destruction of pathogens 'marked' by antibodies **; A** *ref. to* opsonisation **I** stimulates phagocytosis of the pathogen, unqualified	**1**
6(b)	*any **two** from:* **1** removal of introns (from primary transcript) **;** **2** (after removal of introns) exons, are joined together, in different, sequences / combination(s) **; A** alternative splicing **3** not all the exons are used (in making the polypeptides) **; I** capping and poly-A tails	**2**